PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : B61F 5/06, 5/12	A1	(11) International Publication Number: WO 00/13954 (43) International Publication Date: 16 March 2000 (16.03.00)

(21) International Application Number: PCT/IB99/01504

(22) International Filing Date: 3 September 1999 (03.09.99)

(30) Priority Data:
98/8103 4 September 1998 (04.09.98) ZA

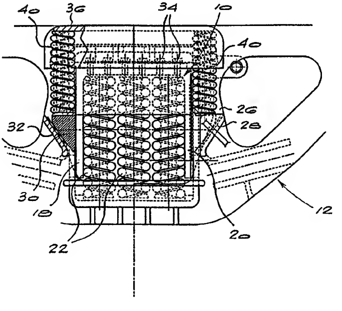
(71)(72) Applicant and Inventor: SCHEFFEL, Herbert [DE/ZA]; 83a Wouw Street, 0181 Groenkloof (ZA).

(74) Agents: GILSON, David, Grant et al.; Spoor and Fisher, P.O. Box 41312, 2024 Craighall (ZA).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: 3-PIECE RAIL BOGIE



(57) Abstract

The invention concerns 3-piece rail bogies of the type which have a transverse bolster (10) and a pair of side frames (12) on which the bolster is suspended at its ends on upright bolster springs (22) acting between the bolster and the side frames. The invention proposes that the bolster ends be formed with downwardly opening concavities (14, 16, 18, 20) to receive the upper ends of the bolster springs. With this feature it is possible to accommodate longer bolster springs than normal, giving an improved ride quality in both the vertical and lateral sense. Alternatively, resilient shear pads can be located beneath shorter bolster springs to take account of allowable variations in rail vehicle coupler heights.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

3-PIECE RAIL BOGIE

BACKGROUND TO THE INVENTION

THIS invention relates to a 3-piece rail bogie and in particular to the bolster suspension of a 3-piece rail bogie.

A 3-piece bogie consists of a transverse bolster and a pair of side frames which are mounted on the wheelsets and on which the bolster is suspended. Conventionally, the bolster is suspended on coil bearing springs located on the spring tray of each of the side frames. In addition, it is common for the ends of the bolster to include pockets which accommodate friction wedges. The friction wedges are biased into the pockets and against vertical guide faces of the side frames by vertical stabiliser coil springs, and provide friction damping to relative vertical and lateral movements between the bolster and side frames. In addition, the friction wedges provide a measure of shear stiffness to the 3-piece bogie. A typical example of a conventional bogie having these features is the so-called "AAR" stabilised truck.

With the above-described arrangement of stabiliser springs the friction damping provided by the friction wedges is load-sensitive, i.e. the damping force is higher for a loaded rail vehicle than for an empty one because the spring deflection of the stabiliser springs is greater for a loaded vehicle than an empty one.

A disadvantage of the arrangement described above is the limitation on the vertical space available for the coil bearing springs attributable to the wedge pockets in the bolster ends.

SUMMARY OF THE INVENTION

According to this invention there is provided a 3-piece rail bogie comprising a transverse bolster and a pair of side frames on which the bolster is suspended at its ends on upright bolster springs acting between the bolster and the side frames, wherein the bolster ends are formed with downwardly opening concavities to receive the upper ends of the bolster springs. In practice, each end of each bolster may include an upper, horizontal member and side walls depending vertically from the horizontal member to define a concavity. The horizontal member and side walls may form a three or four-sided, inverted box defining the concavity.

The lower ends of the bolster springs may bear on spring trays provided by the side frames, in which case it is possible to have relatively long bolster springs which will provide a softer ride, both vertically and laterally. In an alternative arrangement the lower ends of the bolster springs bear on resilient shear pads located in spring trays provided by the side frames.

In an embodiment pockets are provided in the side frames, friction wedges are accommodated in the pockets and stabiliser springs act between the bolster and the friction wedges to bias the friction wedges into the pockets and against upright guide faces of the bolster. There may be four friction wedges per side frame, two of the wedges being located inboard relative to the side frame and being spaced apart from one another on opposite sides of the transverse centre line of the bolster and the other two wedges being located outboard relative to the side frame and being spaced apart from one another on opposite sides of the transverse centre line of the bolster.

The stabiliser springs may act between beams connected to the ends of the bolster and the friction wedges, the beams conveniently being in the form of inverted channels which receive upper ends of the stabiliser springs.

In one alternative configuration pockets are provided in the bolster, friction wedges are accommodated in the pockets and stabiliser springs act between the side frames and the friction wedges. In another alternative configuration, hydraulic dampers act between the side frames and the bolster to provide vertical and horizontal damping therebetween.

According to a preferred feature, the side frames carry resilient buffers arranged to act in the longitudinal direction against the bolster to resist shear deformations of the bolster relative to the side frames. For each side frame there may be a pair of buffers located inboard relative to the side frame and a pair of buffers located outboard relative to the side frame, the buffers in each pair being located respectively fore and aft of the transverse centre line of the bolster.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a partly sectioned side view of a bolster suspension arrangement according to this invention;

Figure 2	shows a plan view of the arrangement;
Figure 3	shows a cross-section at the line 3-3 in Figure 2;
Figure 4	shows a view, similar to that of Figure 1, of a modified arrangement;
Figure 5	shows a view, similar to that of Figure 3, of the modified arrangement of Figure 4;
Figure 6	shows a plan view of a further embodiment of the invention;
Figure 7	shows an enlarged view of a portion of Figure 6;
Figure 8	shows a view corresponding to Figure 1 of another embodiment; and
Figure 9	shows a plan view of the embodiment of Figure 8.

DESCRIPTION OF THE DRAWINGS

The drawings illustrate an end portion of a bolster and one of the side frames of a 3-piece rail bogie. The bolster is indicated with the numeral 10 and the side frame with the numeral 12.

As shown in Figures 1 and 3, the end of the bolster 10 includes an upper horizontal member 14 and three vertical side walls 16, 18 and 20 forming a downwardly opening concavity in the form of a three-sided, inverted box. The bolster end is suspended on the side frame by nine vertical coil bearing or bolster springs 22, arranged in three rows, which act between the underside of the horizontal member 14 and a spring tray 24 forming part of the side frame 12.

It will be understood that the downwardly concave nature of the bolster end permits the use of substantially longer bolster springs than would otherwise be the case. Because of their length, the bolster springs have decreased vertical stiffness, therefore providing a softer vertical ride. Also the length of the springs provides for increased softness in the lateral direction. The softer vertical and horizontal ride which is obtainable is considered to be a major advantage of the invention.

The drawings also illustrate other aspects of bolster suspension system of the invention. Referring in particular to Figure 1, it will be seen that the vertical columns 26 of the side frame 12 are formed with pockets 28 which accommodate friction wedges 30. The friction wedges have inclined faces acting against inclined members 32 of the pockets 28 and vertical faces acting against the side walls 18 and 20 of the bolster end.

Connected to the bolster end by bolts 34 are two longitudinally extending beams 36, one beam being located inboard of the longitudinal centre line 38 of the side frame 12 and the other beam being located outboard of that centre line. There is a total of four friction wedges at each side frame, two of the wedges being located beneath each of the beams 36.

Each friction wedge 30 is biased downwardly into its pocket by a vertical stabiliser coil spring 40 the upper end of which locates in a vertical pocket in the relevant beam 36 and which acts between the beam 36, and hence the bolster itself, and a horizontal upper surface of the wedge. The spring-loaded friction wedges provide friction damping to vertical and horizontal relative motions between the bolster and side frames of the 3-piece bogie. As mentioned previously, they also provide the bogie with shear stiffness. The shear stiffness which is achieved with the arrangement of four wedges per side frame, two inboard and two outboard of the side frame centre line, is considered advantageous in the following respects:

1. The wedges provide resistance to shear caused by longitudinal forces which act in opposite directions to urge one side frame rearwardly and the other forwardly, i.e. a parallelogram-type movement. Such forces occur when the two wheelsets of the bogie are forced to yaw in equal senses, as in curves. In this situation, the described arrangement of four wedges per side frame gives a high level of shear resistance.

2. Shear may also be caused by lateral forces in opposite directions at the axle boxes of the wheelsets which tend to urge the leading wheelset to the right and the trailing wheelset to the left (or *vice versa*). This shear force pattern also occurs in curves as a result of the flange force acting on the leading outer wheel of the bogie. Seen in plan view, these shear forces tend to rotate each side frame about the end of the bolster. The described wedge arrangement offers increased shear resistance because of the presence of two wedges ahead of, and two behind, the transverse centre line of the bolster.

The four-wedge arrangement described above, in which the wedges are widely spaced apart to resist couples, is considered to be advantageous compared to previous arrangements, such as that in the known RDI Truck, which employ four friction wedges per side frame but in which the wedges are in closely spaced pairs.

Although the friction wedge arrangement described above is believed to be advantageous, the invention is not limited to the use of such arrangements. In other embodiments, not illustrated, inclined hydraulic dampers may be provided instead of friction wedges to provide a measure of shear stiffness and to ensure that high frequency vibrations are not transmitted to the rail vehicle body.

It should also be noted that the arrangement described above to provide for longer bolster springs is applicable both to conventional bogies having pedestal side frames resting on metal bearing adaptors place on the axle box roller bearings as well as steerable 3-piece bogies of radial arm, cross-anchor or other type.

It is possible that permissible variations in coupler heights for general purpose rail wagons which run in trains having both loaded and unloaded wagons may not allow for the total available vertical spring travel which can be achieved with the extended length bolster springs described above. In this event, it is possible to use shorter bolster springs and to mount resilient shear pads in the remaining space available. This is shown in Figures 4 and 5 in which the numeral 50 indicates, in each case, a sandwich construction composed of rubber pads 52 interposed between steel plates 54.

The sandwich construction is positioned in each case in the spring tray 24 beneath the bolster springs 22. The shear pad arrangement of Figures 4 and 5 ensures that there is still a relatively soft bolster suspension in the lateral direction although the vertical bolster suspension will be harder than in situations where there are no coupler height restrictions and longer bolster springs can be used.

Figures 6 and 7 illustrate a further modification within the scope of the invention. In this embodiment, resilient bump-stops or buffers 60 are mounted to vertically extending brackets 62 which are integral with the side frame. The buffers 62 extend laterally towards the bolster 10 and lie as close as possible to the horizontal plane of the axles of the bogie. Referring to the more detailed enlargement of Figure 7, each buffer consists of a backing plate 64 bolted to the bracket 62 and a resilient element 66, typically of polyurethane or Vescoflex™, moulded between the backing plate and a steel wear plate 68. The buffers may have any suitable cross-sectional shape such as round or rectangular. There is a very small clearance, typically of the order of 0,1mm, between the wear plate and the vertical face of the bolster 10 to ensure that the buffers will act against the bolster whenever even very small shear deformations take place between the bolster and the side frames. It will be understood that the action of the buffers is to apply an elastic restoring force which will return the bolster/side frame assembly to a square condition, with the bolster at right angles to the side frames in plan.

It will be understood that the buffers provide the bogie with a measure of shear stiffness whether or not the friction wedge arrangement described above or vertical hydraulic damping is used. When present, the friction wedges themselves also provide the bogie with a measure of shear stiffness.

In combination, the buffers and friction wedges can provide sufficient shear stiffness to give the bogie hunting stability, even in the absence of inter-axle shear stiffening arrangements such as cross-anchors or A-frames, which will be adequate for many normal speed applications.

Hunting stability for higher speed applications can be improved further by the inclusion of a degressive yaw constraint apparatus and/or inter-axle shear stiffening apparatus. The degressive yaw constraint apparatus could, for instance, be one of those described in the specification of applicant's co-pending international patent application PCT/IB99/01383 filed on 4 August 1999. It is believed that the degressive yaw constraint arrangements described with reference to Figures 27a and 27b and Figures 28a and 28b of that specification would be particularly suitable in the present application.

The specification of applicant's co-pending international patent application also describes several examples of radial arm-type inter-axle shear stiffening apparatus which could be used, possibly in conjunction with a suitable degressive yaw constraint apparatus, to provide an optimal level of hunting stability for very high bogie speeds.

In the embodiments described above, the downwardly opening concavities which are provided at the ends of the bolsters to receive the upper ends of the bolster springs are, in each case, in the form of a three-sided, inverted box. In the absence of a fourth side wall, the outer extremity or end of the bolster is in each case open. The long bolster springs can be installed through this open end. In other embodiments of the invention, not illustrated, the end of the concavity may be closed by a fourth side wall.

Figures 8 and 9 illustrate another embodiment of the invention. Whereas the pockets 28 accommodating the friction wedges 30 are in the side frame in the previous embodiments, these pockets are provided in the bolster end in Figures 8 and 9, as in conventional arrangements. The presence of the pockets in the bolster end reduces the space available for the bolster springs 22 with the result that there are only seven, as opposed to nine, such springs in this embodiment. In particular it will be noted that there is only a single bolster spring, designated 22.1 between the pockets 28.

It will be appreciated that in Figures 8 and 9 there are only two friction wedges 30 per bolster end, each with a stabiliser spring 40 acting between the side frame and the wedge, as opposed to the arrangement of four wedges and stabiliser springs in the preceding embodiments. The seven spring/two wedge arrangement is not quite as soft as the nine spring/four wedge arrangement, but will still be somewhat softer than conventional arrangements with shorter bolster springs. Increased frame shear stiffness could once again be provided by means of bump stops or buffers as described above in relation to Figures 6 and 7.

It will be understood that an advantage of the embodiment of Figures 8 and 9 is that it facilitates retro-fitting of existing 3-piece bogies, requiring only that the bolster ends be modified in accordance with the invention to accommodate the longer, and accordingly softer, bolster springs and, if necessary, the bump stops or buffers.

CLAIMS

1.

A 3-piece rail bogie comprising a transverse bolster and a pair of side frames on which the bolster is suspended at its ends on upright bolster springs acting between the bolster and the side frames, wherein the bolster ends are formed with downwardly opening concavities to receive the upper ends of the bolster springs.

2.

A bogie according to claim 1 wherein each end of each bolster includes an upper, horizontal member and side walls depending vertically from the horizontal member to define a concavity.

3.

A bogie according to claim 2 wherein the horizontal member and side walls form a three or four-sided, inverted box defining the concavity.

4.

A bogie according to any one of the preceding claims wherein the lower ends of the bolster springs bear on spring trays provided by the side frames.

5.

A bogie according to any one of claims 1 to 3 wherein the lower ends of the bolster springs bear on resilient shear pads located in spring trays provided by the side frames.

6.

A bogie according to claim 5 wherein each shear pad comprises a sandwich construction in which resilient pads alternate with steel plates.

7.

A bogie according to any one of the preceding claims and comprising pockets provided in the side frames, friction wedges accommodated in the pockets and stabiliser springs acting between the bolster and the friction wedges to bias the friction wedges into the pockets and against upright guide faces of the bolster.

8.

A bogie according to claim 7 comprising four friction wedges per side frame, two of the wedges being located inboard relative to the side frame and being spaced apart from one another on opposite sides of the transverse centre line of the bolster and the other two wedges being located outboard relative to the side frame and being spaced apart from one another on opposite sides of the transverse centre line of the bolster.

9.

A bogie according to claim 7 or claim 8 wherein the stabiliser springs act between beams connected to the ends of the bolster and the friction wedges.

10.

A bogie according to claim 9 wherein the beams are in the form of inverted channels which receive upper ends of the stabiliser springs.

11.

A bogie according to any one of claims 1 to 6 and comprising inclined hydraulic dampers acting between the side frames and the bolster to provide vertical and horizontal damping therebetween.

12.

A bogie according to any one of claims 1 to 6 and comprising pockets in the ends of the bolster, friction wedges accommodated in the pockets and stabiliser springs acting between the side frames and the friction wedges.

13.

A bogie according to any one of the preceding claims wherein the side frames carry resilient buffers arranged to act in the longitudinal direction against the bolster to resist shear deformations of the bolster relative to the side frames.

14.

A bogie according to claim 13 comprising, for each side frame, a pair of buffers located inboard relative to the side frame and a pair of buffers located outboard relative to the side frame, the buffers in each pair being located respectively fore and aft of the transverse centre line of the bolster.

15.

A bogie substantially as herein described with reference to the accompanying drawings.

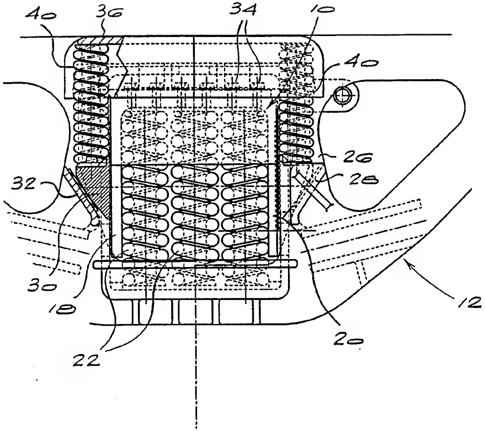


FIG 1

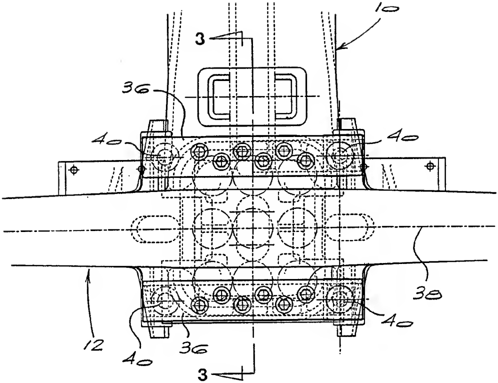


FIG 2

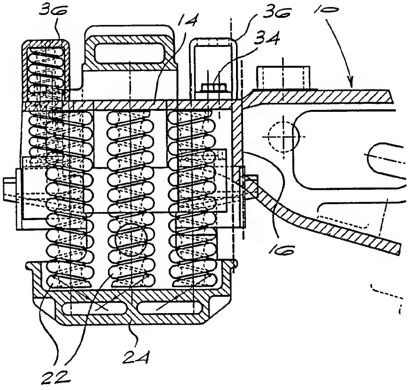


FIG 3

FIG 4

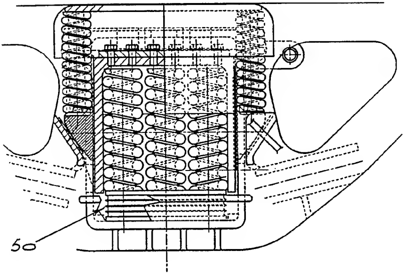


FIG 5

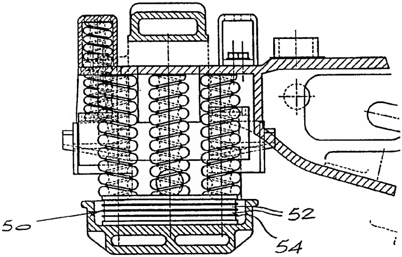


FIG 6

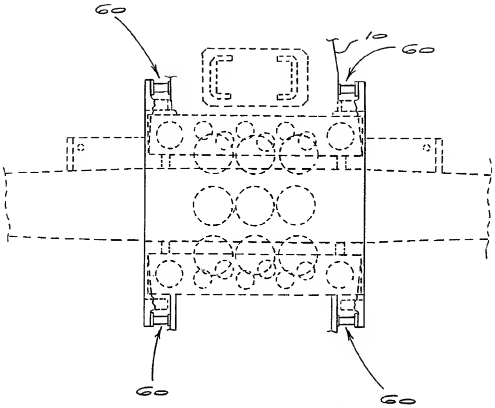


FIG 7

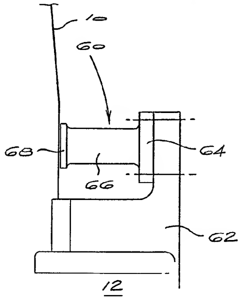


FIG 8

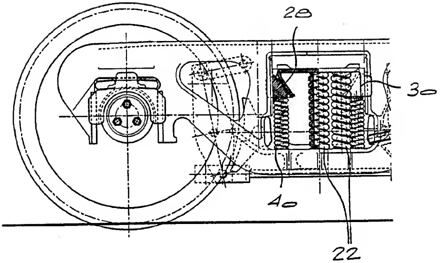
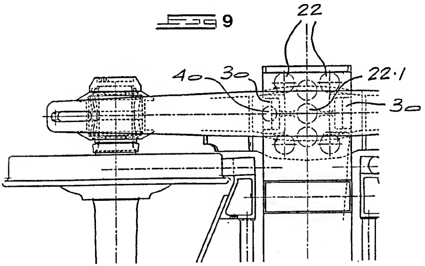


FIG 9



INTERNATIONAL SEARCH REPORT

In ational Application No
PCT/IB 99/01504

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B61F5/06 B61F5/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 4 265 182 A (NEFF ROBERT K ET AL) 5 May 1981 (1981-05-05) column 2, line 28 -column 4, line 34; figures 1-14	1 2-4,7,8
X	US 3 541 970 A (ROSS ALEXANDER) 24 November 1970 (1970-11-24) column 2, line 6 - line 43; figures 1-3	1
X	US 2 097 083 A (J. A. SHAFER) 26 October 1937 (1937-10-26) column 2, line 36 - line 73; figures 3,4	1
A	US 2 538 380 A (H. M. PFLAGER) 16 January 1951 (1951-01-16) column 2, line 3 -column 3, line 12; figures 1-4	5,6
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 November 1999	03/12/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Chlosta, P

1

International Application No
PCT/IB 99/01504

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	DE 25 44 956 A (WAGGON UNION GMBH) 21 April 1977 (1977-04-21) page 7, line 3 -page 9, line 5; figures 1,2	13,14

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int ...tional Application No
PCT/IB 99/01504

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4265182	A	05-05-1981	NONE	
US 3541970	A	24-11-1970	NONE	
US 2097083	A	26-10-1937	NONE	
US 2538380	A	16-01-1951	NONE	
DE 2544956	A	21-04-1977	NONE	